

ward as far as Manitoba; west lows, those from the Pacific coast States and Western States between latitudes 48° and 35°; southwest lows, from Lower California, Mexico, Texas, and the Gulf of Mexico; Atlantic lows, as designated; erratic lows, developing anywhere from the lakes east to the Maritime Provinces, including the New England States.

The lows comprise all those occurring which were sufficiently well defined to be traced on the charts.

In November the number of storms caused by erratic lows is very few in number, even less than in the January series.

The diminution of storms attributable to northwest lows in their eastward advance is also more marked than in January. The number of storms caused by west lows decreases as they progress eastward even more rapidly than does the number caused by northwest lows. This is somewhat opposed to the January conditions. The percentage of storms caused by southwest lows is considerably larger in November in the Lake region than it is either in the lower St. Lawrence Valley and the Gulf or in the Maritime Provinces. This is contrary to what occurs in January and proves pretty conclusively that the southwest low has a tendency to travel more inland in the autumn months than later in the winter. This is certainly instructive. The general characteristics of the Atlantic lows vary very little from those of January, except that their number appears to be slightly greater, and on rare occasions they spread sufficiently far inland to cause a storm on the lakes.

November is generally asserted to be the stormiest month of the year in the Lake region. It is undoubtedly on the average the stormiest month during the season of navigation; the number of heavy gales that occur is not, however, very large although greater than in December, and, whereas, some Novembers may be excessively stormy, others are comparatively free from storms.

In the lower St. Lawrence Valley and the Gulf, also in the Maritime Provinces, November is not as stormy a month as the three succeeding it.

The gales of November have been divided into three classes, those of a very heavy type, the fresh gales, and the moderate storms. Adding the first two classes together the percentage of the fresh to very heavy gales for the districts is as follows: Lower Lakes, 43.1 per cent; lower St. Lawrence and Gulf, 61.8; Maritime Provinces, 49.3. Consequently fresh to heavy gales are more numerous in the lower St. Lawrence Valley and the Gulf than in the Maritime Provinces and much more so than on the Lakes. In the Lake region the gales of a marked heavy type were 43, this number being considerably greater than in the January series. In the lower St. Lawrence Valley and the Gulf the number was 49 which is 19 less than in January, and in the Maritime Provinces, 34, which number is 20 less than in January. As before mentioned the November series embraces one year more than that for January.

The southwest low is responsible for the greatest number of heavy gales and the northwest low is the next, with about half the number.

Apparently no hard and fast rules can be laid down for the development of any gale from the most severe to the most moderate, but there is unquestionably a tendency for types of conditions to be repeated and for a series of storms either to develop in much the same locality or else to move from much the same quarter, their general conditions and accompaniments being very similar; this at times is particularly marked.

The low area with two foci and the low area with the extensive trough, in which the subsidiary development so often occurs in its southern quadrant, are two classes of depressions responsible for some of the heaviest storms.

RECENT PAPERS BEARING ON METEOROLOGY.

W. F. R. PHILLIPS, in charge of Library, etc.

The subjoined titles have been selected from the contents

of the periodicals and serials recently received in the library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a —.

Scientific American Supplement. New York. Vol. 14.

Dexter, Edwin G. Weather Superstitions. Pp. 22534-22535.

— Congress for Protection against Hail in Lyons. Pp. 22536-22537.

— Cobalt Weather Barometer. P. 22538.

Journal of the Manchester Geographical Society. Manchester. Vol. 17.

Greenwood, W. Nelson. The Life of a Wave from its Cradle to its Grave. Pp. 197-222.

Black, J. M. Heat Wave—United States. P. 229.

Science. New York. Vol. 16.

Barus, Carl. Preliminary Results on the Changes of Atmospheric Nucleation. Pp. 948-952.

Symons's Meteorological Magazine. London. Vol. 37.

Schuster, Arthur. Meteorology at the British Association. Address to Sub-section of Astronomy and Cosmical Physics. Pp. 155-159.

Shaw, William N[apier]. Radiation in Meteorology. Pp. 159-161.

Ventosa, V. The Moon and Thunderstorms. P. 161.

Nature. London. Vol. 67.

Shaw, William N[apier]. The Second Installation of the Ben Nevis Observatory. Pp. 61-62.

M., A. B. Summer and Winter. P. 81.

Solomon, Maurice. The Present State of Wireless Telegraphy. Pp. 131-133.

London, Edinburgh, and Dublin Philosophical Magazine. London. Vol. 4.

Cunningham, J. A. The Discharge of Electricity through Gases and the Temperature of the Electrodes. Pp. 684-704.

Rutherford, E. and Allen, S. J. Excited Radioactivity and Ionization of the Atmosphere. Pp. 704-723.

Journal of Geography. Lancaster. Vol. 1.

Jefferson, M. S. W. The Influence of Ponds and Rivers on Atmospheric Temperatures. P. 400-407.

Astrophysical Journal. Chicago. Vol. 16.

Cortie, A. L. Minimum Sun-Spots and Terrestrial Magnetism. Pp. 203-211.

Ciel et Terre. Bruxelles. 23me Année.

Lancaster, A. Étude pluviométrique sur le Bassin de la Meuse. [Note on article by D. Vanhove.] P. 457-460.

L., V. D. L'état actuel de la question du tir contre la grêle. Pp. 460-461.

— De l'origine des "Mistpoeffers." [Note on work by M. Oldham.] Pp. 461-462.

— L'ozote des eaux de pluie et des eaux de drainage. P. 462.

L., V. D. Une ascension aérostatique célèbre. Pp. 465-472.

— Échanges de chaleur entre le sol, l'eau et l'atmosphère. [Note on article by Schubert.] P. 488.

Annuaire de la Société Météorologique de France. Paris. 50me Année.

Angot, Alfred. Rapport sur la Conférence Internationale tenue à Graz (Styrie) du 20 au 25 juillet 1902, pour l'étude des tirs contre la grêle. Pp. 193-197.

Moureaux, Th. Perturbation atmosphérique du 13 juillet 1902. Pp. 195-199.

Comptes Rendus de l'Académie des Sciences. Paris. Tome 135.

Guillaume, J. Observations du soleil, faites à l'Observatoire de Lyon pendant le troisième trimestre de 1902. Pp. 887-889.

Archives des Sciences Physiques et Naturelles. Genève. 4me période. Tome 14.

Gautier, R. Observations météorologiques faites aux fortifications de Saint-Maurice pendant les mois de décembre 1901, janvier, février et mars 1902. Pp. 303-311.

Gautier, R. Observations météorologiques faites aux fortifications de Saint-Maurice pendant les mois d'avril, mai, juin et juillet 1902. Pp. 442-449.

Gautier, R. Résumé météorologique de l'année 1901 pour Genève et le Grand Saint-Bernard. Pp. 564-589.

Annales Agronomiques. Paris. Tome 28.

Justiniani, E. Sur la végétation de certaines plantes à la lumière solaire directe et à l'obscurité. [Note on article by N. Passerini.] Pp. 576-577.

Annalen der Hydrographie und Maritimen Meteorologie. Hamburg. 30 Jahrgang.

Hoeck, —. Barometrische Depressionen an der äquatorialen Grenze des Golfstromes im Februar 1902. Pp. 559-563.

Das Wetter. Berlin. 19 Jahrgang.

Sprung, A. Einige Gedanken zum Rüstzeug eines Meteorologischen Observatoriums. Pp. 241-246.

- Rotch, A. Lawrence.** Die Cirkulation der Atmosphäre in den Tropen und am Aequator. Pp. 251-257.
- Rimpau, W.** Die Wirkung des Wetters auf die Zuckerrüben-Ernten der Jahre 1891 bis 1900. Pp. 258-260.
- Drachenversuche an Bord von Dampfern. Pp. 262-263.
- Physikalische Zeitschrift. Leipzig. 4 Jahrgang.*
- Thiel, A. and Abegg, F.** Ueber Tropfenbildung bei Rauch. Pp. 129-132.
- Meteorologische Zeitschrift. Wien. Band 19.*
- Ekholm, Nils.** Ueber Emission und Absorption der Wärme und deren Bedeutung für die Temperatur der Erdoberfläche. P. 489-505.
- Hervé Faye. P. 505-506.
- Robert Rubenson. P. 506.
- Maurer, J.** Professor Dr. Heinrich v. Wild. P. 506.
- Fényi, J.** Ueber Luftspiegelungen in Ungarn. Pp. 507-509.
- Hann, J.** Klima am oberen Schari im französischen Sudan. Pp. 509-512.
- Ergebnisse der meteorologischen Beobachtungen zu Guatemala im Jahre 1901. Pp. 512-513.
- Zum Klima von Martinique. Pp. 513.
- Magnetische Elemente am Observatorium in Valentia. Pp. 513-514.
- Hann, J.** Maxwell Hall über die Temperatur von Kingston Jamaika und deren Beziehungen zur Sonnenfleckenperiode. Pp. 514-515.
- Hergesell, —.** Vorläufiger Bericht über die internationale Ballonfahrt vom 3. April 1902. Pp. 515-516.
- Hergesell, —.** Vorläufiger Bericht über die internationale Ballonfahrt vom 1. Mai 1902. Pp. 516-517.
- Hergesell, —.** Vorläufiger Bericht über die internationale Ballonfahrt vom 5. Juni 1902. Pp. 517-518.
- Hergesell, —.** Vorläufiger Bericht ueber die internationale Ballonfahrt vom 3. Juli 1902. Pp. 518-519.
- Hergesell, —.** Vorläufiger Bericht über die internationale Ballonfahrt vom 7. August 1902. P. 519.
- Hergesell, —.** Vorläufiger Bericht über die internationale Ballonfahrt vom 4. September 1902. Pp. 519-520.
- Taudin Chabott, J. J.** Der sogenannte Sonnenuntergang und das optische Verhalten der Atmosphäre nach den jüngsten Aeusserungen vulkanischer Thätigkeit in Mittelamerika (mit Tafel). Pp. 520-521.
- Danckelman, v.** Ergebnisse der meteorologischen Beobachtungen in Deutsch-Südwestafrika 1900-1901. Pp. 521-523.
- Polis, P.** Das Gewitter zu Aachen am 30 Juni 1902. Pp. 523-525.
- Laska, W.** Das Wetter und die Telegraphendrähte. Pp. 525-526.
- Bergholz, P.** Klima von Bremen. Pp. 526-527.
- Meteorologische Beobachtungen auf Belle Isle 1900-1901. Pp. 527-528.
- Boccara, E.** Ueber die tägliche Variation der atmosphärischen Refraktion. P. 528.
- Birkeland, Kr.** Resultate der magnetischen Untersuchungen der norwegischen Expedition zum Studium der Polarlichter 1899-1900. Pp. 528-530.
- Reimann, —.** Zur Höhe der Gewitterwolken. Pp. 530-531.
- Grundmann, G.** Der Schreiber'sche Nadelkohörer. P. 531.
- Harmattan auf der See beobachtet. P. 532.
- Meteorologie von Nieder-Kalifornien. P. 532.
- Thermische Wirkung der Doppelfenster. P. 532.

CLIMATOLOGICAL DATA FOR JAMAICA.

Through the kindness of H. H. Cousins, chemist to the Government of Jamaica and now in charge of the meteorological service of that island, we have received the following table in advance of the regular monthly weather report for Jamaica:

Comparative table of rainfall for November, 1902.

Divisions.	Relative area.	Number of stations.	Rainfall.	
			Average.	1902.
	Per cent.		Inches.	Inches.
Northeastern division	25	21	10.97	9.47
Northern division	22	47	5.85	2.55
West-central division	26	21	6.06	6.42
Southern division	27	32	4.78	3.97
	100	121	6.91	5.60

The rainfall was, therefore, below the average for the whole island. The highest fall recorded was 31.27 inches, at Moore Town, in the northeastern division, while 0.30 inch fell at Round Hill, in the northern division.

CLIMATOLOGY OF COSTA RICA.

Communicated by H. PITTIER, Director, Physical Geographic Institute.

[For tables see the last page of this REVIEW preceding the charts.]

Notes on the weather.—On the Pacific slope rain was rather scarce, although pretty continuous during the first half of the month. In San Jose the pressure was slightly under the normal; temperature higher; rainfall in deficit for about one-third of the average, with an excess of five days. On the Atlantic coast the rainfall was excessive, while it was deficient, although not scarce, at the stations of the interior at the foot of the Cordillera.

Notes on earthquakes.—November 16, slight shock at 6^h 2^m a. m., direction ENE-WSW, intensity II, duration 3 seconds. November 26, trepidatory movement at 1^h 40^m p. m., intensity III, duration 12 seconds. November 28, 9^h 45^m p. m., slight shock, N-S, intensity IV, duration 7 seconds. (The same day a slight shock was felt at Cachi at 9^h 45^m p. m., same direction).

ANNUAL WIND RESULTANTS.

By T. H. DAVIS, New Haven, Conn., dated February 20, 1902.

I do not believe that mathematical methods, inductive or deductive, will ever bring us to any clear conclusion as to the general circulation of the atmosphere, neither will it do to assume general physical laws as sufficient. The oscillatory movements and the progressive changes of winds can, I firmly believe, only be solved by careful, faithful observations and patient perseverance, and I respectfully submit the following contribution to the numerical method of treatment.

As a basis for a systematic investigation of annual frequencies of wind direction, I have used the directions recorded hourly, as given in full in the successive Annual Reports of the meteorological services of the United States and Canada, for the ten years 1891-1900; twenty-eight stations belong to the United States and six to Canada. From these I have computed the resultant directions, thereby obtaining figures that are as free as possible from the effect of the diurnal variation of the wind. The general method of computation is shown in the example copied in Table 1.

TABLE 1.—Computation of annual resultant directions from hourly records of winds.

BISMARCK, N. DAK.					
Observed.		N.	E.	S.	W.
Direction.	Number.				
N.....	852	852			
NE.....	677	479			
E.....	1,266		1,266		
SE.....	1,060		749	749	
S.....	530			530	
SW.....	377			267	267
W.....	768				768
NW.....	3,033	2,149			2,144
Totals.....	8,563*	3,475	2,494	1,546	3,179
Surplus.....		1,546			2,494
		1,929			685
Resultant..... N. 21° W.					

*The difference between this number and the 8,760 hourly observations is due to calms and missing records.

All the resultants thus computed for each of the years 1891-1900 are given in Table 2. It will be noticed that instead of reckoning directions uniformly from the north point eastward around the circle I have started from either one of the four cardinal points, north, south, east, or west, as seemed most appropriate in each case. In general it will be seen that westerly winds have prevailed during this decade at all stations, except those in the region extending from Salt Lake City and Kansas